Office of Environmental Management

Technology Development and Deployment Project Plan

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I. Introduction

In an effort to more directly support opportunities identified in the Office of Environmental Management (EM) cleanup acceleration initiatives, EM-1 has directed the Office of Environmental Cleanup and Acceleration to "projectize" its Technology Development and Deployment (TDD) program. This represents a transition from the current approach, which is to develop technologies that are alternatives to existing site baseline technologies, to provide short-term technical assistance, and support for near-term closure needs. The projectized approach is to address the technology needs being identified by the EM sites that will enable them to accelerate their cleanup schedules and/or provide technical foundations for the sites' Risk-Based End States (RBES) visions. The intent of moving TDD into a project mode is to fully align the TDD activities, now through the time of site closure, with the sites' cleanup activities. As indicated by a review of existing site Performance Management Plans and site baselines, such a focus would allow a significant shortening of the TDD effort itself and associated cost savings. The current Integrated Planning, Accountability, and Budgeting System indicates a TDD completion date of 2020. The end-date for TDD requirements, but not necessarily the closure date itself, is defined as the End-of-[TDD] Mission. EM plans to recast its TDD budget structure with the results of this Project Plan.

In a memorandum to field managers on June 14, 2004, EM-1 requested the Office of Environmental Cleanup and Acceleration to work directly with each of the sites to review their current technology needs. For those needs that are not addressed by the site contractor, the sites were requested to identify technology needs that would enable them to accelerate their cleanup schedules. For those technology needs that EM should address, funding estimates and priorities were established in consultations between headquarters and field contacts. In order to provide timely analyses for the Environmental Management fiscal year (FY) 2006 Office of Management and Budget submission, these consultations and documentation were completed in July and August, 2004.

EM's strategic goal, as stated in DOE's strategic plan, is "to protect the environment by providing responsible resolution to the environmental legacy of the Cold War and by providing for the permanent disposal of the Nation's high level radioactive waste." In February 2002, EM's Top-to-Bottom Review team reported that EM's past cleanup performance had been characterized by uncontrolled cost and schedule growth and a misplaced emphasis on managing risk, rather than reducing risk to workers, the public, and the environment.

In response to that review, the cleanup program now focuses on configuration-controlled baselines and metrics for achieving site cleanup and closure in accordance with individual site Performance Management Plans. This effort is structured in three phases, which are represented within the EM budget process with three funding accounts: (1) sites scheduled to close by 2006, (2) sites scheduled to close by 2012, and (3) sites scheduled to close by 2035. EM's present cleanup plan is targeted to complete cleanup of legacy waste at a total estimated life-cycle cost of $142 billion (constant FY 2003

dollars). EM's vision for its cleanup program includes a strong, technically-based effort to search continually for ways to accelerate the completion of the program.

This acceleration effort, which primarily affects those sites with high-level waste, significant soil or ground water contamination, and large quantities of legacy transuranic wastes, will involve examining, modifying, and pursuing opportunities for accelerating their overall cleanup schedule. Among possibilities for acceleration is the application of technology to reduce the resources required for high-cost elements of the legacy waste cleanup program (e.g., dispositioning of tank wastes).

Cleanup completion activities at small sites will continue to receive significant senior management attention. After an in-depth review of each small site and its cleanup challenges, it became clear to EM that the path forward for the closure of small sites involves developing and executing credible cleanup plans, including an agreed upon risk-based end state. Those small sites included in the 2006 – 2012 interval have a range of technology requirements that were considered in the selection of TDD candidates. The small sites were also candidates for technical assistance in identifying existing technologies that will accelerate closure and reduce costs.

The EM mission requires research and development (R&D) and applied technology to achieve schedule acceleration and reduction in baseline technical risks. Alternatives to baseline technologies need to be developed that can reduce programmatic risks, improve schedules, and reduce costs. The purpose of this Plan is to identify technically improved or most cost-effective R&D and technology options to accelerate closure, or provide technical assistance to near-term closure sites. It is anticipated that the transition to the new TDD project structure will be conducted in two phases. The first phase, which is reported in this Plan, addresses a short term need to provide a basis for the FY06 budget request. A second phase is planned to be conducted in conjunction with the FY 2007 budget formulation cycle to provide additional time for sites to identify their complete technology needs and budget through to the end-of-mission.

II. Methodology

Subsequent to the June 14 memorandum from EM-1 to the field, the following sites were invited to submit proposals for consideration in the preparation of the TDD Project Plan (TPP): Savannah River (SR), Oak Ridge (OR), Idaho (ID), Hanford (ORP and RL), Ohio (OH), Portsmouth/Paducah, Carlsbad, West Valley and Rocky Flats. Due to the limited amount of time for the preparation of this Plan, the prioritization of candidate technologies for each site was done jointly and in parallel with close contact between the respective site and headquarter's contacts. The primary means of communicating progress was through weekly conference calls and iterative assessments of TDD candidates by email and telephone exchanges between the site and headquarters contacts.

A TDD data template was prepared and distributed to site contacts for review and consensus. Following agreement on the format, site representatives worked with site contractors and managers of current baseline technology development to complete the template for each proposed technology.

EM staff analyzed the requests for the potential to accelerate risk reduction and remove technical barriers in closure projects. Remaining questions were then discussed with site contacts, who also provided additional clarification and in some cases provided site priorities among the proposed technologies. Following these discussions, a recommended list of needs for new funding was provided to EM management. At the same time, reviewers were asked to identify significant site problems or technology needs that were not identified in site proposals. Final decisions were made primarily upon expert judgment of subject matter reviewers and whether the proposals overlapped or could be more effectively addressed with ongoing plans for Technical Assistance or Alternatives Projects.

III. Summary of Technology Needs for Achieving Accelerated Risk Reduction and Closure

A total of 87 proposals were received from the sites. They related primarily to four major problem areas: High-Level Waste, Ground Water and Soils, Decontamination and Decommissioning, and Transuranic Waste. Rocky Flats and Carlsbad did not submit technology needs as they were being addressed by other means. The Ohio office, Portsmouth/Paducah and West Valley submitted closure needs with strong justifications for near-term technical assistance beginning with FY05 funding and execution that will be reviewed separately by EM. The distribution of proposals is provided in the table below.

Table 1. Site vs. Technical Needs

	ID	ORP	OR	RL	SR	OH[1]	Ports/ Pad[1]	WV[1]	Total
HLW	2	11			9			2	24
TRU/Pu/SNF	3		1	3	1				8
GW/S	4		13	3	4	9	9		42
D&D	2		2	2		6		1	13
Total	11	11	16	8	14	15	9	3	87

[1] Technical Assistance Needs

Results of the review confirmed that there are a number of R&D needs that DOE must address in the future to provide technology solutions across the DOE complex. A majority of these activities are needed because there is no current solution available, and the site will be unable to meet or accelerate their cleanup and closure schedules. The problem areas are discussed below.

High-Level Waste

Retrieval, treatment and disposal of high level waste (HLW) is one of EM's most challenging and costly programs. Wastes at ORP, INEEL, and SR must be treated and immobilized, and prepared for shipment to a repository for disposal. Storage and processing facilities must be cleaned up, closed, and brought into conformance with site risk-based end states. TDD is needed in each of these areas to accelerate schedules, cut costs, and reduce programmatic risk. Twenty-four proposals were received from HLW sites in the following areas: retrieval of sludges and solids, separation of wastes into HLW and low activity waste (LAW) fractions, waste processing of both HLW and LAW, means to increase higher waste loading in glass, and tank closures. The needs that were validated based on the methodology described in Section II. are summarized in Table 2.

Table 2. HLW TDD Needs

Title	Need Description
Office of River Protection	
Bulk Vitrification Enhancements	Improved supplemental technology to process 50-70% of Hanford low activity waste (LAW)
Improved Retrieval Methods	Retrieval of insoluble salts and sludges from known/suspected leaking HLW tanks
In-Situ Tank Residuals Inventory	Characterization for the purposes of closure of key radionuclides left in HLW tanks after retrieval
Tank Residuals Release Mitigation	Reduced transport of radionuclide and other contaminant migration from tanks after closure
Tank Residuals Long-Term Immobilization	Reduced release of radionuclides and other contaminants from HLW after closure
Resorcinol Formaldehyde (RF) Resin Testing	Robust, low cost separation process for the removal of Cs from HLW in the Waste Treatment Plant (WTP)
Aluminum Leaching	Reduction in the number of HLW canisters produced in the (WTP)
Improved Filtration	Increased throughput for WTP pretreatment (separation into HLW and LAW fractions)
Oxidative Leaching	Reduction in the number of HLW canisters produced in the WTP
HLW Loading Improvements	Increased HLW melter throughput and reduction in the number of HLW canisters produced in the WTP
Savannah River	
Treatment of DWPF Recycle	Increased volume availability in SRS HLW tanks to allow HLW processing flexibility
Increased Melt Rate and Waste Loading in HLW Glass	Increased HLW melter throughput and reduction in the number of HLW canisters produced in the DWPF
New Compositions and Technologies to Increase Loading in HLW Glass	Increased HLW melter throughput and reduction in the number of HLW canisters produced in the DWPF
Increased Ti Loading Limits in HLW Glass	Increased HLW melter throughput and reduction in the number of HLW canisters produced in the DWPF
Sludge Heel Retrieval	Reduction in the volume of waste residuals in HLW tanks to allow closure
Radionuclide (Tc^{99}, Np^{237}, I^{129}) Leaching from Sludge	Reduction of the radionuclide content of waste residuals in HLW tanks to allow closure

Ground Water and Soils

Forty-two proposals were submitted that relate to ground water and soils contamination, which reflects the significance of this issue at every cleanup site. The time horizon for the proposals spanned from the current time (closure sites) to long times that are associated with intractable and widespread contamination by chlorinated solvents, metals, and radionuclides, e.g. Richland, ID, OR, and SR. Many of the longer term problems also capture needs that are common to establishing risk-based end states, such as characterization instrumentation to confirm performance confirmation and long-lasting solutions, e.g. better caps or barriers.

Inherent to this problem are the long-lifetime contaminants of concern -- radionuclides (Tc, Np, Pu), mercury and other toxic metals, and organics. Experience with caps, barriers, and other current containment methods is limited to deployment of new techniques for the past 10-20 years, and longer-term performance is uncertain. Current regulatory approaches extend for 30 years following closure.

For purposes of evaluation, proposals were considered within three categories. These were monitored natural attenuation, in situ treatment, and characterization/monitoring. These categories captured common themes among proposals from all sites.

An understanding of processes that affect the long-term effectiveness of natural attenuation is crucial to gaining confidence in planned site closure methods and regulatory acceptance. Several proposals were received that have good potential for sharing and enhancing technical progress across several sites. These were given a high priority. For example, ID and RL have similar unsaturated zone issues, and SR and RL have work underway that will benefit all sites.

In situ methods of treatment may be the only way to address remediation of persistent and toxic metals, principally mercury, and longer-lived radionuclides. To this end, proposals were received for in situ stabilization or immobilization techniques, and were also given a high priority.

Longer term monitoring and characterization of pre- and post-closure site environments are recognized in the TDD proposals, which are primarily related to needs for "tools" or methods to assure confidence in the performance of closed sites. Although important, this area may require a broader involvement of multi-site planning efforts to agree upon technology development needs.

The needs that were validated based on the methodology described in Section II. are summarized in Table 3.

Table 3. Ground Water and Soils TDD Needs

Title	Need Description
Richland	
In Situ Remediation of Vadose Zone /Groundwater Carbon Tetrachloride	In-situ remediation of carbon is needed for control of groundwater concentrations below regulatory limits.
In Situ Characterization/Near Term Monitoring of Soil Contaminated by Heavy Metals and other Ions	There is a need to develop unobtrusive, surface geophysical technologies to characterize chemical and radiological contamination in the underlying vadose zone at Hanford.
Research and Development of the Permeable Adsorptive Barrier (PAL)	Lower total life-cycle costs than the traditional double-lined barrier system.
Idaho	
Enhanced Natural Attenuation of Carbon Tetrachloride in Surficial Sediment and Groundwater	There is a need to evaluate bioremediation to reduce the CCl4 concentration in the vadose zone as an alternative to the baseline approach of vapor extraction.
Dynamic Compaction Within the Subsurface Disposal Area	Elimination of voids in the buried waste zone is needed to reduce differential subsidence and intentional rupture of some waste packaging.
Oak Ridge	
Characterization of Contaminant Sources Under Storm Drains	To identify sources of methylmercury and/or polychlorinated biphenyl (PCB) contamination in fish that occurs in surface waters downstream from OR facilities.
Chlorinated Solvent Treatment-Wetlands	To identify actions for controlling transport and discharge of a complex dissolved-phase plume of chlorinated hydrocarbon contaminants to Mitchell Branch from the ETTP site.
Electrochemical Remediation to Remove Mercury in Soils	Less expensive alternative than the current baseline (low Temperature Thermal Desorption) pretreatment prior to landfill disposal.
Thermal Fixation of Radionuclide Contaminated Soil	Alternatives to engineered barriers to ensure long-term effectiveness fixation of contaminants
In Situ Treatment Alternatives for Mercury Contaminated Soils	An in situ technology is needed for the Y-12 81-10 area to prevent mercury from being transported to the adjacent Upper East Fork Poplar Creek by storm water surface runoff.
Mercury in Fish Reduction with Source Treatment	Reduce the accumulation of methylmercury in fish in waters downstream from the DOE Y-12 NSC in Oak Ridge.
Evaluation of Natural Attenuation Treatment of Groundwater Plumes	Cheaper and sustainable TCE remediation of groundwater in the 7000 area at the Oak Ridge National Laboratory.
Technologies to Support Risk-Based End States	To identify monitoring strategies that can supplement or eventually replace long-term monitoring requirements being planned for key site closure activities at OR.
Stabilization of Radionuclide Contaminated Soil in Corehole 8	To provide temporary stabilization of the soil until issues are resolved for shipment of RH TRU to WIPP. The preferred method of temporary stabilization is in situ freezing.
Savannah River	
Evaluation of Natural Attenuation (NA)	Remediation of groundwater plumes by NA processes and new monitoring techniques to reduce long-term monitoring costs for the SRS groundwater plumes.
MNA/EA of Metals and Radionuclides	To provide a cost effective means for the identification and evaluation of SR and other sites where monitored natural attenuation may be a viable technology.

Decontamination and Decommissioning

Thirteen proposals from multiple sites indicated the need for a "toolbox" of D&D supporting technologies for dust suppression and fixative applications. The D&D of gaseous diffusion plants requires a larger set of innovative tools, as was indicated by a proposal for a vendors conference. This problem is being partially addressed through a currently funded alternatives project at Portsmouth.

One of the largest and most unique D&D challenges that the Department faces is the Alpha-4 Facility at Oak Ridge. Through a number of various processes conducted in the facility since 1947, there are thousands of pounds of solidified lithium remaining in the equipment and process lines, thousands of pounds of elemental mercury, mercury-contaminated equipment and structures, and hundreds of gallons of lithium hydroxide. Removal of these contaminants presents a serious risk to workers and the environment.

The needs that were validated based on the methodology described in Section II. are summarized in Table 4.

Table 4. D&D TDD Needs

Title	Need Description
Idaho	
Treatment and Disposal Path for Irradiated Be	Disposal of beryllium and other metals from test reactors that contain TRU and other activation products
Retrieval Operation Airborne Reduction	High airborne concentrations of contaminants and waste particles during TRU waste retrieval
Oak Ridge	
Technology for Dismantlement of Gaseous Diffusion Plant Facilities	Safe, efficient, and cost effective D&D of massive gaseous diffusion plant facilities
D&D of the Alpha 4 Facility	Safe, efficient, and cost effective removal and treatment of contaminants, especially mercury and lithium, during D&D

Transuranic Waste

Eight proposals were received from the sites on subjects related to the retrieval, treatment, and assay of transuranic waste. As mentioned in the TRU Waste Performance Management Plan there are several key technologies that need to be developed to achieve accelerated cleanup. These technologies will enhance characterization, transportation and disposal activities.

Development of characterization using NDA/NDE assay instruments for large TRU containers is a high priority item at all TRU-handling sites. SRS has requested additional funding to assist with certification of this characterization technology.

Other proposals among the eight submitted appeared to fit more appropriately in site cleanup baseline funding. These specific needs that recognized related technologies under development for deployment addressed mostly characterization and some treatment of contact handled TRU. As situations are clarified, that more specific needs will be identified for additional characterization of various TRU inventories, handling and packaging of contact and remote handled wastes, and the support needed for certification of transportation of TRU wastes will be critical in meeting accelerated schedules.

The needs that were validated based on the methodology described in Section II. are summarized in Table 5.

Table 5. TRU TDD Needs

Title	Need Description
Richland	
Improved U Metal Analysis	Process control to limit hydrogen concentrations during the removal of sludge from K basins
618-10/11 Burial Grounds	Location and retrieval of remote handled TRU during cleanup of the 618-10/11 burial grounds
Size Reduction, Repackaging, and Storage of RH-TRU Waste	Safe size reduction, repackaging, and storage of RH-TRU waste prior to final disposition
Idaho	
MLLW Without a Current Disposal Path	A treatment and disposal path must be identified for 144 m^3 of mixed low level waste (MLLW) at Idaho
TRU Box Assay	Retrieved TRU waste boxes must be surveyed to allow proper certification and disposal
Oak Ridge	
Mixing and Sampling of Melton Valley Storage Tanks (MVST)	Levels of transuranic elements in the MVST sludges may be lowered enough to avoid disposition as TRU at WIPP
Savannah River	
NDA/NDE Technologies for Large TRU Boxes	Characterization of large-volume TRU waste boxes at SRS and other sites without repackaging for shipment to WIPP

Technical Assistance

Twenty-seven proposals from the Ohio, Portsmouth/Paducah, and West Valley sites were received. The Ohio and West Valley proposals request technical assistance to meet very near-term closure needs, beginning now or within the next few months. The Portsmouth/Paducah proposals request a broad range of remediation assistance, primarily related to burial grounds' closure and contaminated ground water and soil. The subjects of the technical assistance proposals are shown in Table 6, below.

Table 6. Technical Assistance Needs

Title	
PORTSMOUTH	**OHIO**
X701B Injection	Converted Advanced Wastewater Treatment Project (CAWWT) Controls Request
In Situ Anaerobic Reactive Zone Treatment of DNAPL at the X749 Landfill	CAWWT KPA Instruments
PADUCAH	Concrete Demolition/Reduction
Efficient Excavation of Landfills	Portable Negative Air Enclosure
Cleanup of the C-749 Burial Ground	Groundwater Exit Strategy
TCE Plumes	Large Tank Heel Mgt and Radon Suppression
DNAPL Remediation	Minimizing Wastewater – Silo Waste Retrieval
DNAPL Detection System	Restoration Soil Amendment
Tc^{99} Plume Remediation	PRS 76 VOC Remediation
PCB Disposal	Rail Infrastructure Remediation
WEST VALLEY	Real-Time Monitoring Data
Technology for Closure of HLW Tanks	Sewer Re-Route
Remote Tool for Segregating Highly Radioactive and Mixed Wastes	SSOD Validation for CAWWT
High-Pressure Liquid CO_2 D&D System	Auto Lube System
	Dust Contamination Control

IV. Summary

A total of 87 needs were identified by the sites, addressing HLW, Ground Water and Soils, D&D, and TRU waste. There was a high degree of interest among sites in filling gaps in technology needs that currently do not fall within contractor responsibilities. Some of these needs are partially being addressed by ongoing work under Alternatives Projects or through technical assistance activities, but more support is needed in those cases that were assigned a high priority. Examples include NDA work for TRU shipments, HLW treatment alternatives, and ground water remediation. Ohio, Portsmouth/Paducah, and West Valley submitted needs proposals to achieve closure in 2006 and beyond, and these will be addressed by EM. EM will continue to assess the TDD needs through completion of all EM site cleanup efforts and reflect the results of the assessments in this Plan.